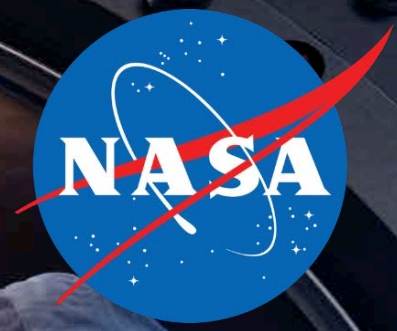


Human Health and Performance for Space Exploration




Julie Robinson, Ph.D., Associate Director
NASA Human Research Program

17 April 2019



All content in this presentation has been previously released by NASA.



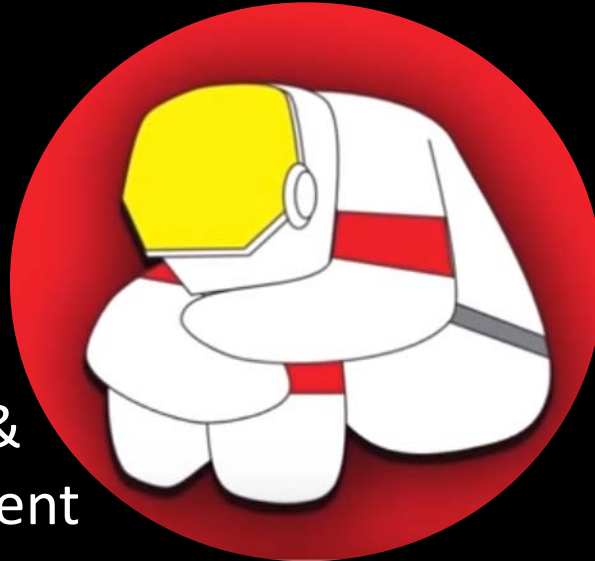
Human travelers to Mars will experience unprecedented biological, physiological, and psychosocial challenges that could lead to significant health & performance decrements during and after the mission

**NASA's Human Research Program is responsible for
Characterizing the effects of spaceflight and developing mitigation strategies**

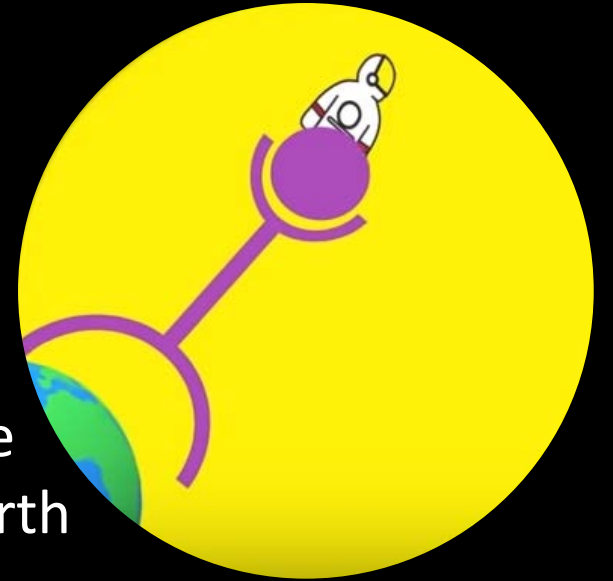
5 Hazards of Human Spaceflight



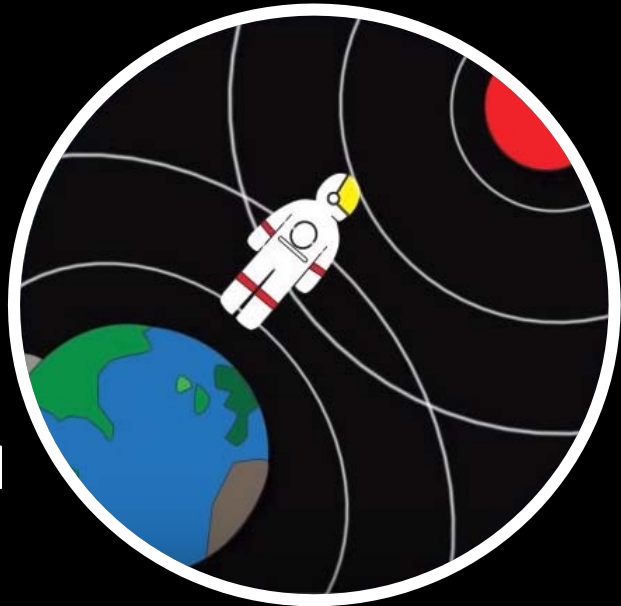
Space
Radiation



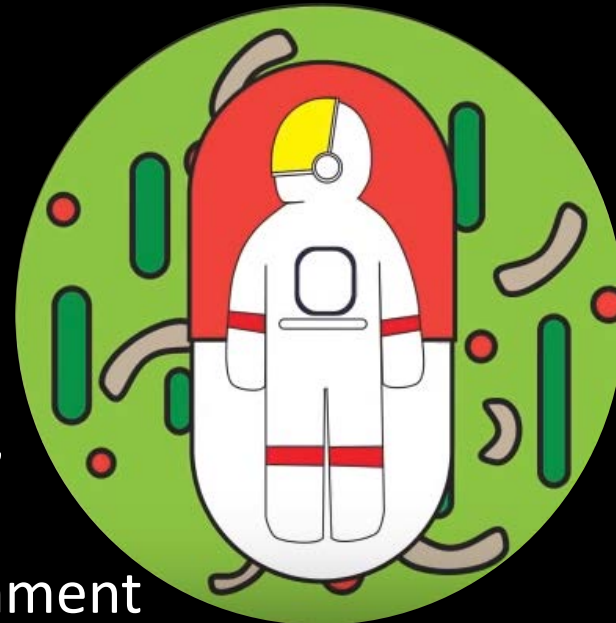
Isolation &
Confinement



Distance
from Earth

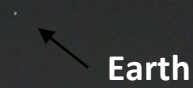


Altered
Gravity



Hostile,
Closed
Environment

Crew Stressors in Deep Space Missions



Altered Gravity Fields

- Balance Disorders*
- Fluid Shifts & Visual Alterations*
- Cardiovascular Deconditioning*
- Muscle Atrophy & Bone Loss*

Radiation Effects

- Acute, in-flight effects*
- Long-term cancer risk*
- CNS and Cardiovascular*

Hostile Closed Environment

- Vehicle Design*
- Environmental – CO₂ Levels,*
- Toxic Exposures, Microbiome*
- Food/Nutrition*

Isolation/Confinement

- Behavioral aspect of isolation*
- Sleep disorders*

Distance from Earth

- Communication delay*
- Autonomous medical care capacity –*
- no emergency evacuation*

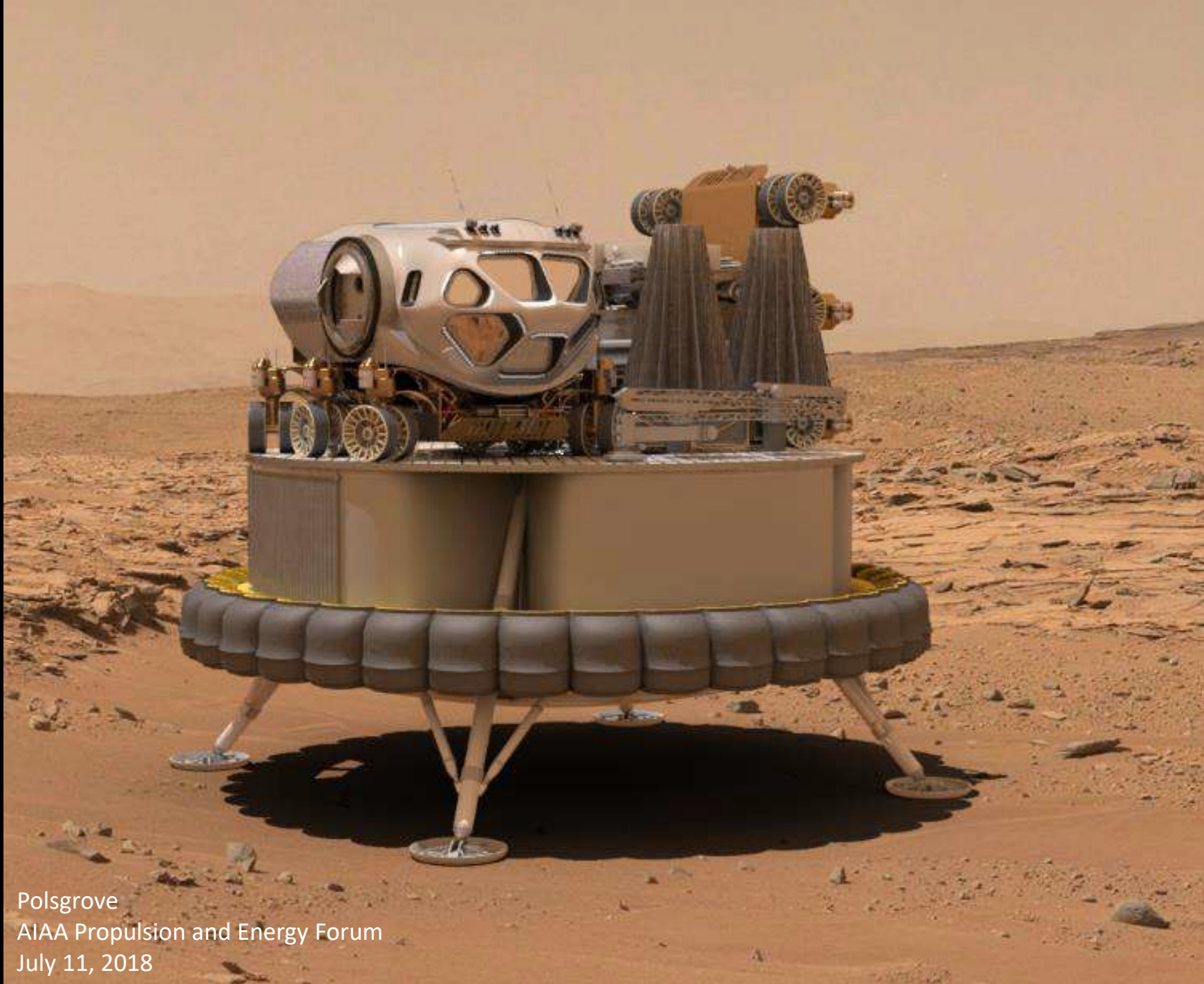
Astronauts on a Mars mission will experience unprecedented physiological, environmental, and psychosocial challenges.

Lunar Surface Research Operations

Depending on mission design and duration, Lunar Surface Operations Missions could add significantly to our understanding/mitigation/validation of human health and performance risks during future Mars surface missions.

- **Autonomous egress/ post-landing operations**
- **Long-term habitation/exploration**





Polsgrove
AIAA Propulsion and Energy Forum
July 11, 2018